

UNITED STATES PATENT OFFICE

2,501,737

SOLUTION FOR PLATING METALS
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Jones, Chelsea, Mass.No Drawing. Application September 11, 1946,
Serial No. 696,380

3 Claims. (Cl. 106—1)

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This invention relates to the plating of metals by mere immersion without heat or electrolytic action, and more especially to the plating of base metals with gold in this manner.

Heretofore, metals have been plated with gold by electrolysis, a method which requires the heating of the solution. The heating of the solution causes evaporation, which results in reducing the plating efficiency thereof. An electrolytic solution is weakened, also, by the transposition of gold from the gold anode thereof to the solution because the gold transposed from the anode to the solution does not enter into composition with the gold chloride solution.

Our method, in addition to being more economical than the electrolytic method, produces a more even coating of gold, which eliminates the necessity for buffing. No gold anode is required and the plating process is carried out with a cold solution.

One of the uses to which our invention may be put is the plating of grids of radio tubes and other electron discharge devices. It has long been the practice to plate the grids of radio tubes electrolytically to reduce the absorption of air by the grid and diminish the secondary emission therefrom due to molecular bombardment. It has been the experience of tube makers that when tubes having gold-plated grids are bombed, the gold particles fly off the grids, which usually are made of molybdenum or tungsten and are supported by nickel side rods. However, when the grids are plated by our composition and process, the plating will remain intact under the bombing process.

Our process and solution may also be used in plating the interior surface of a hypodermic needle, which is about two-hundredths of an inch in diameter, without clogging, thereby prolonging the useful life of the needle, the inner surfaces of which frequently corrode and cause clogging.

We have found that various metals, for example, nickel, tungsten, and molybdenum, can be plated with gold by mere immersion in our solution and without the use of electrolysis or heat.

The solution which we prefer at the present time comprises distilled water, gold chloride, sodium phosphate, potassium cyanide, and acetic acid, and, when the metal to be plated is nickel, nickel chloride (nickel carbonate) is included.

The quantities of the ingredients of our solution having a water content of 375 cubic centimeters (375 grams) of distilled water, which we

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have found to be the minimum practicable solution, are substantially as follows, prior to dissolving them in 375 cubic centimeters of distilled water:

Gold chloride 3.9 grams; nickel chloride or carbonate, when used, 3.9 grams; sodium phosphate, tribasic, 47.5 grams; potassium cyanide 47.5 grams; acetic acid, 18 cubic centimeters, i. e., 18.88 grams.

Expressed in percentages, the quantitative relation of the ingredients prior to dissolution in 375 cubic centimeters of distilled water, may be defined substantially as follows:

Gold chloride .79% by weight; nickel chloride (carbonate), when used, .79% by weight; sodium phosphate, tribasic, 9.57% by weight; potassium cyanide 9.57% by weight; acetic acid 3.78% by weight (18 cubic centimeters); distilled water 75.50% by weight.

When the metal to be plated is other than nickel, and the water content of the solution is 375 cubic centimeters, (375 grams), the quantities of the ingredients prior to their dissolution in 375 cubic centimeters of distilled water are substantially as follows:

Gold chloride 3.9 grams; sodium phosphate 47.5 grams; potassium cyanide 47.5 grams; acetic acid 18.0 cubic centimeters, i. e., 18.88 grams.

Expressed in percentages, the quantitative relation of the ingredients when nickel chloride (or nickel carbonate) is omitted, prior to dissolution in 375 cubic centimeters of distilled water, may be defined substantially as follows:

Gold chloride .79% by weight; sodium phosphate 9.63% by weight; potassium cyanide 9.63% by weight; acetic acid 3.82% by weight (18 cubic centimeters); distilled water 76.13% by weight.

Our experience has been that the maximum practicable solution is one having a water content of about 4500 cubic centimeters.

It is to be understood that while we have stated specifically the exact quantities which we have found to be useful, practicable, and efficient, we do not limit ourselves thereto, because the proportions are capable of variations. We have found that the rate of increase of each ingredient with respect to the water content is substantially linear.

The ingredients preferably are mixed as follows, to wit: first, the gold chloride is completely dissolved in the distilled water; next, the sodium phosphate (tribasic) is added and thoroughly dissolved; then, the potassium cyanide is dissolved therein; and finally, the acetic acid is added to the solution, slowly and without agita-

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tion or stirring. After the evolution of a negligible quantity of gas caused by the addition of the acetic acid has ceased, it is advisable to stir the solution to effect the thorough dissolution of the ingredients and to insure uniformity throughout. The acetic acid co-ordinates the other ingredients into a solution that will give the desired result.

When the metal to be plated is nickel, the above procedure is followed down to and including the addition to the solution of potassium cyanide, then the nickel chloride (or nickel carbonate) is added and thoroughly dissolved, and, finally, as before, the acetic acid is added in the manner above set forth. When nickel chloride is used, the solution must be stirred to effect the thorough dissolution of the same, but when nickel carbonate is used, there will be a violent evolution of gas which will effect the thorough dissolution of the nickel carbonate. It is to be understood, of course, that nickel carbonate is the full chemical equivalent of nickel chloride, insofar as the present invention is concerned. The nickel salt is necessary only when the metal to be plated with gold is nickel. By the solution containing nickel chloride (carbonate) metals other than nickel can be plated with gold, e. g., tungsten and molybdenum, which frequently are used for the side bars or supports of radio tubes and other electron discharge devices.

The grid wire, or other metallic member to be plated, is placed in the solution above described, and after remaining therein a short period of time, for example, 15 seconds for a small grid, to about two minutes for a larger article, is removed by nonmetallic means, for example, glass pliers.

The solution is stable and will not deteriorate with lapse of time if enclosed within a sealed container.

We are aware that various solutions have been proposed for gilding metals with gold. Our solution, however, is not to be confused with such gilding solutions because the film of gold formed by them on other metals is readily removed by scouring or even by handling, while by our solution the metals immersed therein are plated with gold even more firmly than by electrolytic deposition, as shown by the fact that when grids of radio tubes are plated by our solution, the plating remains intact under the bombing process.

As at present advised, it is our belief that the acetic acid when dissolved in water breaks up into hydrogen ions or cations, which carry posi-

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tive charges, and anions, which are ions carrying negative charges.

Acetic acid belongs to the class of so-called "weak" acids because only a small portion of a given quantity thereof breaks up into hydrogen ions or cations, and anions, upon the complete dissolution of such quantity in water. It is for this reason, as we believe, that acetic acid is the best acid for use as the acid element of our solution.

Having thus described illustrative embodiments of our invention, without, however, limiting the same thereto, what we claim and desire to secure by Letters Patent is:

1. A solution for plating metals with gold by immersion only, comprising before the dissolution thereof in distilled water, the following ingredients in substantially the proportions by weight hereinafter stated, to wit, gold chloride .79%, nickel chloride .79%, tribasic sodium phosphate 9.57%, potassium cyanide 9.57%, acetic acid 3.78%, and distilled water 75.50%.

2. A solution for plating metals with gold by immersion only, comprising before the dissolution thereof in distilled water, the following ingredients in substantially the proportions by weight hereinafter stated, to wit, gold chloride .79%, nickel carbonate .79%, tribasic sodium phosphate 9.57%, potassium cyanide 9.57%, acetic acid 3.78%, and distilled water 75.50%.

3. A solution for plating metals with gold by immersion only, comprising before the dissolution thereof in distilled water, the following ingredients in substantially the proportions by weight hereinafter stated, to wit, gold chloride .79%, tribasic sodium phosphate 9.63%, potassium cyanide 9.63%, acetic acid 3.82%, and distilled water 76.13%.

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